

Thermal Marangoni flow past a permeable stretching/shrinking sheet in a hybrid Cu-Al₂O₃/water nanofluid

ABSTRACT

The present study accentuates the Marangoni convection flow and heat transfer characteristics of a hybrid Cu-Al₂O₃/water nanofluid past a stretching/shrinking sheet. The presence of surface tension due to an imposed temperature gradient at the wall surface induces the thermal Marangoni convection. A suitable transformation is employed to convert the boundary layer flow and energy equations into a nonlinear set of ordinary (similarity) differential equations. The bvp4c solver in MATLAB software is utilized to solve the transformed system. The change in velocity and temperature, as well as the Nusselt number with the accretion of the dimensionless Marangoni, nanoparticles volume fraction and suction parameters, are discussed and manifested in the graph forms. The presence of two solutions for both stretching and shrinking flow cases are noticeable with the imposition of wall mass suction parameter. The adoption of stability analysis proves that the first solution is the real solution. Meanwhile, the heat transfer rate significantly augments with an upsurge of the Cu volume fraction (shrinking flow case) and Marangoni parameter (stretching flow case). Both Marangoni and Cu volume fraction parameters also can decelerate the boundary layer separation process.

Keyword: Dual solutions; Hybrid nanofluid; Marangoni convection; Stability analysis; Suction